

A3

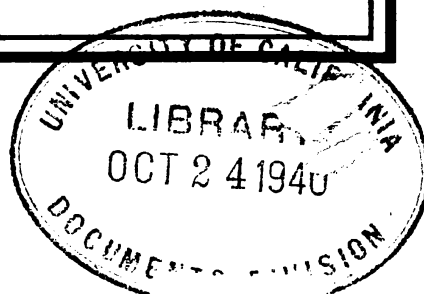
TM 10-610

*1/4 Bd. Archive
new*

L415 WAR DEPARTMENT

TECHNICAL MANUAL

REFRIGERATION COMPANY



FOREWORD

This manual is intended for use as a guide in the organization and administration of the Refrigeration Company as prescribed in T/O 10-217 dated January 1, 1940.

TECHNICAL MANUAL }
No. 10-610

WAR DEPARTMENT,
WASHINGTON, October 1, 1940.

REFRIGERATION COMPANY

Prepared under direction of
The Quartermaster General

U113
.2
TM 10-610
★ ★

	Paragraph
SECTION I. Company headquarters and headquarters platoon	1-12
II. Butchery platoon	13-22
III. Cold storage platoon	23-35
IV. Refrigeration platoon	36-37
V. Attached veterinary	38

SECTION I

COMPANY HEADQUARTERS AND HEADQUARTERS PLATOON

	Paragraph
Organization commander	1
First sergeant	2
Staff sergeant (chief clerk)	3
Mess sergeant	4
Supply sergeant	5
Company clerk	6
Stock records clerks	7
Watchmen	8
Staff sergeant (maintenance foreman)	9
Sergeant (storekeeper)	10
Noncommissioned officers in charge of activities or details	11
Other headquarters platoon personnel	12

1. Organization commander.—The organization commander, in addition to being a refrigeration engineer familiar with both operation and maintenance of refrigeration equipment, is responsible for the administration, sanitation, training, discipline, and supply of the refrigeration company. In the discussion of duties of the various personnel, it is to be remembered that final responsibility for all activities is the company commander's and that this responsibility may not be delegated to subordinates.

2. First sergeant.—Under supervision of the company commander, the first sergeant is responsible for preparation of all reports, rosters, and routine correspondence pertaining to the organization; has general supervision of supply and messing of the organization; is

responsible for presence of personnel at formations and roll calls as directed by the organization commander.

3. Staff sergeant (chief clerk).—Under supervision of the company commander, the staff sergeant is responsible for proper distribution of incoming orders, tallies, requisitions, and correspondence; for maintaining files and insuring that prompt and proper action is taken on correspondence when necessary; has general supervision of office and office personnel including stock record clerks.

4. Mess sergeant.—Under the company commander, the mess sergeant is responsible for arrangement for and procurement of food supplies; proper preparation and serving of food, sanitation of mess facilities and personnel, proper safeguarding of mess equipment, preparation of menus and subsistence requisitions.

5. Supply sergeant.—Under the company commander, the supply sergeant is responsible for supply of the organization including clothing, equipage, arms, and ammunition; is responsible to the company commander for safeguarding of the above property and for timely submission of requisitions to augment or replace that property; for proper accomplishment of all records necessary in accounting for issues of the property to individuals.

6. Company clerk.—Under the first sergeant, the company clerk is responsible for preparation of correspondence and such other clerical duties as may be assigned to him.

7. Stock record clerks.—Under the chief clerk, stock record clerks are responsible for proper entries on stock records of all transactions pertaining to receipt or issue of ice and cold storage supplies; for checking all incoming tallies against shipping tickets and for checking all outgoing tallies or issues against approved requisitions.

8. Watchmen.—Under the organization commander, watchmen are responsible for proper protection of the refrigeration plant and supplies.

9. Staff sergeant (maintenance foreman).—Under the organization commander, the staff sergeant is responsible for proper maintenance and repairs of the refrigeration plant and has as his assistants one sergeant (assistant maintenance foreman), one private (carpenter), one private (electrician), one private (plumber), and one private (welder).

10. Sergeant (storekeeper).—Under the organization commander, the sergeant (storekeeper) is responsible for actual checking of supplies received, preparation of the corresponding incoming tally, checking of supplies issued, and preparation of the corresponding outgoing tally.

11. Noncommissioned officers in charge of activities or details.—Noncommissioned officers in charge of activities or details are responsible for presence at designated places of duty of all personnel under their jurisdiction and for reports to the first sergeant of absence of any member or members of their platoon not at such designated place of duty.

12. Other headquarters platoon personnel.—Other headquarters platoon personnel are assigned to duties as is prescribed in T/O 10-217.

SECTION II

BUTCHERY PLATOON

	Paragraph
Function.....	13
Cutting and boning	14
Meat cutting equipment	15
Cutting frozen meats.....	16
Cutting and boning chilled meats.....	17
Check weighing.....	18
Slaughter of live animals.....	19
Slaughtering equipment	20
Slaughter requirements.....	21
Duties of personnel	22

13. Function.—The function of the butchery platoon is to cut quarters of beef into wholesale market cuts; to cut wholesale market cuts into cuts suitable for mess use; to bone beef and other meats; and, when necessary, to slaughter and dress meat animals. This platoon may also be called upon to operate a defrosting room.

14. Cutting and boning.—The cutting and boning of carcasses and wholesale market cuts of beef, veal, mutton, lamb, and pork, the scaling and dressing of fish, and the drawing and cutting of poultry are described and illustrated in TM 10-405 (now published as TM 2100-152).

15. Meat cutting equipment.—Cutting and boning rooms should be so arranged that the introduction, the cutting, boning, packaging, and removal of the meat can proceed with the least amount of labor. Saws, cutting and boning tables, packaging tables, etc., should be so arranged as to provide a progressive movement of the meat. Each platoon should be provided with facilities for sharpening knives and saws (grindstones, whetstones, files, etc.). The sharpening of band saws requires expert technique and special equipment. Knives should be rough-sharpened on a grindstone, finished on a smooth whetstone, and during operations, the edge should be kept smooth and straight by the use of a smooth, polished steel. Power saws should be in-

spected frequently, should have adequate guards to prevent injury to workmen, and should be kept in perfect repair. Boning and cutting tables should be made of nonodorous wood sufficiently thick and heavy to be substantial and firm. Exposed metal parts of tables upon which knives could strike cause injury to the cutting edges of knives and lower efficiency. Tables and trucks with which meat comes in contact, and saws, knives, hooks, and other tools used to handle meats must be kept scrupulously clean. All sawdust resulting from the sawing of meats must be removed. Table tops and other equipment must be washed or otherwise cleaned daily. Wet floors favor bacterial and mold growth. Fresh, clean sawdust helps to keep floors dry and the air sweet. Meat should never be allowed to come in contact with rough walls. The temperature of cutting and boning rooms should be kept under 60° F. Butchers, boners, and meat handlers should dress in outer clothing that can be readily washed and sterilized.

16. Cutting frozen meats.—Frozen carcass beef can be cut into pieces small enough to be used in the kitchen only by means of a power-driven band saw. While frozen meats may be sawed by means of a hand saw, the process is too slow and difficult for quantity production. With a band saw, one man can saw a frozen beef carcass into wholesale market cuts in approximately 6 minutes and into kitchen size cuts (roasts, etc.) in from 10 to 20 minutes, depending upon the number of small cuts. At that rate, it would require three band saws operating 24 hours a day to cut the beef required to feed 120,000 men daily. Frozen quarters cannot be boned until after they have been defrosted. Proper methods of defrosting meats and fish are described in TM 10-405 (now published as TM 2100-152). Defrosted meat should be kept cold until used. It is far better to deliver frozen beef to the kitchens in a frozen state. Frozen beef or other frozen meats, if wrapped and packaged, can be safely shipped and held without refrigeration for 24 hours, but it should not be unwrapped and exposed to warm air. All meats, whether chilled or frozen, should be protected from contamination by insects, dirt, etc., by adequate wrapping or packaging. The butchery platoon should be provided with facilities for wrapping and packaging cut meats for distribution.

17. Cutting and boning chilled meats.—If beef and other meats are to be boned, boning should be accomplished before freezing. Boneless beef, properly packed, requires only about one-third the storage space required for frozen quarters. Also, frozen beef must be almost completely defrosted before it can be boned. The boning

of fresh beef is described in conjunction with beef cutting in TM 10-405 (now published as TM 2100-152). An experienced butcher can cut a 600-pound fresh chilled carcass of beef into wholesale market cuts in approximately 12 minutes and can bone one carcass in 1 hour. At that rate, it would require 275 man-hours of labor, or three shifts of 12 men working 8 hours each, to bone the beef required for 120,000 men. Additional men are required to place quarters on the cutting table and remove the cut meat, bones, etc. Chilled meats must be kept under refrigeration continuously until they are to be prepared in the kitchen.

18. Check weighing.—All carcasses and wholesale market cuts should be checked and weighed when entering the cutting room and all cuts checked and weighed out. There is always a loss resulting from cutting or boning meats, varying from one-half of 1 percent to $1\frac{1}{2}$ percent. Loss in weight in bones, fat, and sinew resulting from boning carcass beef of specification grade averages about 25 to 27 percent.

19. Slaughter of live animals.—When called upon, the butchery platoon may be required to slaughter and dress beef animals for troops on the march or at points not accessible to prepared supplies. Veterinary service should be provided during the slaughter of live animals to comply with Army Regulations. The slaughter of food animals, the handling of dressed carcasses, and the disposition of edible byproducts and inedible offal are described in Subsistence Bulletin No. 18, Fresh Meats.

20. Slaughtering equipment.—For small-scale slaughter, the following very simple equipment may suffice:

a. Means of securing animals for stunning. Animals may be put in a knocking pen or be snubbed to a tree, post, or a ring in the floor by means of a rope.

b. Hammer for stunning. A $3\frac{1}{2}$ pound, double-headed sledge with beveled edges and with a 36-inch handle is best for stunning animals, but any similar sledge can be used.

c. Knives for sticking, skinning, etc. While knives such as are used in cutting beef may be used for this purpose, it is desirable to use knives designed for the uses intended.

d. Receptacles for blood, unless facilities are available to drain the blood away.

e. Receptacles for viscera.

f. Saws and cleavers for splitting carcasses. Hand saws are used in temporary installations, and power saws for rump sawing in permanent installations.

g. Hoists to hoist carcasses for bleeding and for eviscerating and hide dropping.

h. Shackles and gambrels for suspending carcasses.

i. Brushes for washing dressed carcasses.

j. Hot water for washing carcasses and steam for cleaning and sterilizing equipment.

k. Chill rooms for chilling carcasses and edible organs (livers, hearts, tongues, etc.).

l. Racks upon which to handle edible organs for chilling.

m. Facilities for disposal of fats (chilling tanks, hashers, rendering tanks, etc.).

n. Facilities for disposal of inedible products (stomach contents, feet, horns, etc.).

o. Facilities for sharpening edged tools.

p. Facilities for washing outer clothing.

21. Slaughter requirements.—For very limited slaughter, butchering may be done in the open with crude and temporary equipment. For large-scale slaughter, however, permanent installations with modern facilities are essential. To supply beef for 120,000 men, approximately 275 beef cattle averaging 1,000 pounds live weight must be killed daily. The dressed carcasses from these cattle should weigh about 165,000 pounds. This beef must be chilled. Nineteen thousand pounds of hides would require salting and 8,500 pounds of edible organs require chilling and handling. Thirty-six thousand pounds of inedible waste would have to be disposed of by burning, burying, reduction to fertilizer, or other means. Approximately 50 expert butchers would be required to kill and dress and handle the byproducts from 275 beef cattle in 8 hours, with modern equipment. A much larger number of inexperienced men would be required for the same task.

22. Duties of personnel.—It is the duty of the butchery platoon to conduct slaughter of live animals when necessary, and to cut or otherwise prepare meats for kitchen use. The second lieutenant supervises all operations of the butchery platoon and coordinates the operations of this platoon with the operations of the cold storage platoon and headquarters platoon. The foreman (staff sergeant) has direct charge of all work details and supervises all killing, cutting, and boning activities. Butchers (privates, 2d and 4th class specialists) should be experienced knifemen who perform all meat cutting and boning. Meat handlers (6th class specialists and privates) handle all meats from trucks to cutting and boning tables, and transfer the cut meats to packages or to trucks for shipment or distri-

bution. Basic personnel (privates) perform duties not otherwise specifically assigned.

SECTION III

COLD STORAGE PLATOON

	Paragraph
Function	23
Inspection of incoming supplies.....	24
Check weighing.....	25
Sanitation.....	26
Handling of supplies.....	27
Conservation of refrigeration.....	28
Chill room requirements.....	29
Sharp freezer requirements.....	30
Holding freezer requirements.....	31
Medical supplies	32
Storing miscellaneous supplies.....	33
Loading for distribution.....	34
Duties of personnel	35

23. Function.—The function of the cold storage platoon is to receive all food supplies of a perishable nature (fresh, chilled, and frozen) and perishable medical supplies and unload, handle, store, and reload such supplies for shipment. The refrigeration of perishable food products is described in Subsistence Bulletin No. 21, Refrigeration. It is desirable that the cold storage platoon provide itself with a copy of this bulletin.

24. Inspection of incoming supplies.—A veterinary inspector should always be present at the cold storage plant to pass upon the soundness and condition of arriving perishable supplies and the condition of the rolling stock upon arrival. Cars and trucks used in transporting perishable supplies should be clean, sweet, and sound enough to protect the contents against adverse conditions. The temperature inside refrigerator cars and trucks upon arrival is usually a good criterion of the condition of the cargo carried therein, particularly if the period of travel has been long. The inspector should note these conditions upon arrival of cars and trucks to determine suitability of the contents for storage. An offensive odor emanating from a conveyance when it is opened should cause suspicion of the condition of the contents. Leaky roofs may render supplies unfit for storage even though spoilage has not already taken place. Cars and trucks carrying meats and similar perishable supplies should have an inside temperature not higher than 40° F. If a higher temperature exists, the product should be carefully inspected for sliminess. Conveyances carrying frozen meats and other frozen

foods should have an inside temperature not higher than 25° F. If inside temperatures are above 32° F., products should be inspected for defrosting. Products in which deterioration is evident should not be stored but should be used as soon as possible. During unloading, car, truck, and refrigerator doors should be left open as little as possible to conserve refrigeration. During the period the refrigerator is being filled or emptied, a doorman should be stationed at the door to prevent undue loss of refrigeration. Refrigerated docks aid in maintaining products in good condition during unloading.

25. Check weighing.—All products arriving for storage should be checked for net weight, count, or measure, depending upon the unit of purchase or storage. All products admitted to storage should have the net weight, number of units, or other data conspicuously marked on the outside of containers or wrappings. It is seldom necessary to weigh or check every parcel, but a check of a sufficient percentage should be made to determine that the marked weights or count are accurate.

26. Sanitation.—All persons handling food supplies should be dressed in clean, washable outer clothing, particularly for handling fresh meats. For handling packaged goods, outer clothing that will resist wear is essential. Trucks and other conveyers should be scrupulously clean and in good working condition to avoid wasting energy. The use of hooks in handling packaged foods is undesirable because of the liability of injury to the contents of the packages.

27. Handling of supplies.—The amount of labor required for unloading and storing supplies varies with the kind and adequacy of facilities present. For products in fiberboard or wood containers, ladder conveyers are desirable for short distances on the level or slightly down grade. For chilled carcass beef and wholesale market cuts, overhead rails and trolley conveyers offer the most rapid and easiest method of conveying meats from unloading dock to storage room. The most employed method of handling supplies is the use of trucks, of which there are many kinds. The extent to which trucks should be loaded depends upon the power available, inclines to be traversed, smoothness of the floor, size of doorways, etc. Where tractors are available, trucks may be loaded heavier than where manpower alone is used. Packages should be piled securely on trucks to prevent falling which might cause injury to attendants or the product.

28. Conservation of refrigeration.—Entrances to refrigerators should be provided with air locks to prevent entrance of outside air directly into refrigerators, particularly in hot weather. Air locks

are particularly needed at entrances to freezers. Trucks should be admitted to the air lock and the outer door closed before the refrigerator door is opened.

29. Chill room requirements.—The storage space required and the approved method of stowing varies with the various perishables. A temperature of 32° to 36° and 138 cubic feet of space are essential for each 600-pound carcass of freshly dressed beef. A temperature of 32° and about 240 cubic feet of space are required for each 1,000 pounds of freshly killed hog carcasses. The temperature required for freshly killed lamb and mutton carcasses is the same as for beef, but more storage space is required. Beef carcasses chill satisfactorily in about 36 hours; hog carcasses in 18 to 24 hours; lamb and mutton carcasses in 24 to 36 hours. All freshly killed carcasses must be suspended from an overhead rail, or similar means, with no two carcasses touching at any point, and with adequate space above and below for free circulation of air. Chilled carcasses may be stored more compactly but should never be piled. Wholesale market cuts should be hung from hooks. Fresh meats in boxes may be piled safely if thoroughly chilled, but should never be stored long without freezing. Pork and pork products have a limited storage life in a chilled state. One week is the limit fresh pork should be stored without freezing.

30. Sharp freezer requirements.—For freezing fresh meats, a temperature below 0° F. is essential. Carcass veal, beef, lamb, or pork should be suspended from overhead rails or similar means to allow free circulation of air entirely around each carcass, side, or quarter. When properly hung in a sharp freezer having a temperature of -10° F., beef quarters will freeze solid in 72 hours; veal and lamb carcasses in 36 hours; and pork in 48 to 72 hours, varying with the weight and fatness of the pork carcasses. For freezing packaged meats, the boxes or other containers should be placed on floor racks in staggered formation to allow free circulation of air on all sides of each container. Forced-air circulation hastens freezing. An improvised wind tunnel can be made by spreading tarpaulins over the top and sides of the product to be frozen, with a propeller fan at one end to drive the cold air through the pile. In a wind tunnel, such products will freeze in less than half the time necessary for freezing in still air.

31. Holding freezer requirements.—Frozen foods should be stowed as compactly as possible to conserve space and to retard dehydration. Circulation of air through the frozen product is not essential or desirable. Carcass meats and packaged products are piled as compactly as possible. The height of piles of frozen products is limited only by floor load limits and safety considerations.

Rectangular packages stack securely; packages of uneven contour do not stack so securely and must not be piled high enough to become a hazard. Frozen products must be stored at temperatures sufficiently low to maintain them in a solidly frozen condition. Holding freezers are ordinarily maintained at 10° to 15° F. This temperature is adequate for holding most frozen products indefinitely. However, butter must be held at 0° F. for safekeeping.

32. Medical supplies.—Medical supplies of a perishable nature usually require a constant temperature sufficiently cold to prevent bacterial decomposition, but not so cold as to freeze the products. The Medical Department indicates the optimum temperature for storing such supplies.

33. Storing miscellaneous supplies.—Lard, lard substitute, eggs, and cheese keep best at chill room temperature (32° to 40° F.) For long storage, shell eggs should be stored at approximately 32° F. Egg cases should be stowed on floor racks with space between stacks and the cases in the stacks separated by wood strips so as to allow free circulation of air around each case. Because of the natural odor of eggs, they should never be stored in the same room with products that might absorb odors, such as butter and lard. Likewise, eggs absorb foreign odors and should not be stored in the same room with onions or other odorous products. Frozen eggs should be stored in a sharp freezer. Type II bacon does not require refrigeration, but its keeping qualities are enhanced when stored at temperatures below 50° F. Type I bacon does not need refrigeration for short storage, but must be held in mild refrigeration (40° to 50°) for extended keeping. Dry vegetables, such as beans and rice, do not need refrigeration to prevent bacterial spoilage, but storage in cold rooms prevents insect infestation or inhibits their development. Roots and tubers (onions, potatoes, etc.) must be protected against freezing in severely cold weather and against heat deterioration in hot weather. Best storage temperatures are between 40° and 50°, with good circulation of air. Ordinarily, such products are not stored in artificially refrigerated storage, but are stored in pits, cellars, and basements where a fairly constant temperature and good ventilation can be had.

34. Loading for distribution.—The loading of storage supplies for distribution to troops is approximately the reverse of unloading and storage procedure. Meats, either fresh or frozen, may have to pass through the cutting room for cutting or boning by the butchery platoon. When frozen meat must be defrosted for cutting or boning, such meat is delivered from storage rooms to the defrosting room.

In handling supplies from cold-storage rooms to cars or trucks for distribution, cleanliness of clothing and equipment is essential. Care must be taken to handle all supplies expeditiously to prevent loss of refrigeration and to prevent exposure of chilled or frozen products to the deteriorating influence of heat. Refrigerator cars should be properly precooled and iced before loading begins. Car temperatures should not be higher than those indicated for incoming cars. All racks, hooks, and other equipment with which products come in contact should be scrupulously clean and conveyances should be free from foreign odors. Nonrefrigerated trucks carrying perishable supplies should be covered with paulins or other protective material. The temperature in such trucks can be improved by frequently showering the coverings with water.

35. Duties of personnel.—The cold storage platoon is charged with the safe and prompt handling of all perishable supplies at refrigerators. Sanitary inspections are conducted by attached veterinary personnel. The first lieutenant of the cold storage platoon has general supervision of all cold storage procedure and the handling of supplies and coordinates the work of his platoon with that of the butchery, refrigeration, and headquarters platoons, and attached veterinary personnel. The foreman (technical sergeant) and assistant foreman (staff sergeant) have charge of all work details. It is their duty to see that all supplies are handled promptly, safely, and in a sanitary manner. The duties of the checkers and scalers (corporals) are to check, weigh, count, or otherwise verify quantities of supplies entering and leaving the cold storage plant. The freezermen (privates) receive loaded trucks, spread, pile, or stack incoming commodities for freezing or storage and load outgoing supplies on trucks or other conveyers. The platform men (privates, sixth-class specialists and privates) load all incoming supplies on trucks or other conveyers and load for distribution all outgoing supplies. The truckers (privates) truck all incoming supplies from unloading docks to refrigerators and all outgoing supplies from refrigerators to defrosting room, cutting room, or loading deck.

SECTION IV

REFRIGERATION PLATOON

	Paragraph
Function	36
Duties of personnel	37

36. Function.—The principles of refrigeration, the operation of a refrigerator plant, and the manufacture of ice are described in Sub-

sistence Bulletin No. 21, Refrigeration. It is recommended that the refrigeration platoon provide itself with a copy of this bulletin. The functions of the refrigeration platoon are to operate all refrigeration machinery, including ice-making equipment, to have charge of all refrigerants, including the making of refrigeration brine, to be responsible for the maintenance of proper temperatures within refrigerated areas, and to operate humidifying equipment, ozone machines, and other installations incident to the maintenance of proper refrigeration conditions. In an installation such as is contemplated in Tables of Organization, ammonia is the refrigerant commonly used. Sharp freezers are refrigerated by direct expansion of ammonia or by low-temperature calcium chloride brine; holding freezers by calcium chloride brine or direct expansion of ammonia; and chill rooms by sodium chloride brine. The compression system of ammonia recovery is most commonly used. Compression machines may be driven by electricity or by steam. Steam boilers may be heated with oil, coal, or other fuel. Water-treating equipment may be necessary for ice manufacture if the water available is very hard. Maintenance of equipment is the function of the plant service section of the headquarters platoon.

37. Duties of personnel.—The first lieutenant has general supervision of all activities of the platoon and coordinates the work of the refrigeration platoon with that of the cold storage and headquarters platoon. The engineer and foreman (technical sergeants) and the assistant foreman (sergeant) are charged with supervision of the refrigeration and air conditioning machinery, ice making, brine making, etc. The refrigeration mechanics (privates, 2d class specialists) are charged with the actual operation of all refrigeration machinery. Oilers and temperature men (privates, 5th class specialists) record and regulate temperatures in refrigerated areas and attend to the lubrication of moving machinery. The duties of the firemen (privates, 6th class specialists) vary with the kind of equipment (automatic stokers, etc.) and the kind of fuel (oil, coal, gas) used. Ice pullers (privates) fill, handle, and empty ice cans and store the ice. Basic personnel (privates) constitute a labor squad for the performance of duties not otherwise assigned.

SECTION V

ATTACHED VETERINARY

Duties of personnel..... Paragraph 38

38. Duties of personnel.—Under regulations, the Veterinary Corps is charged with the inspection of food supplies of animal origin and the sanitary handling of such supplies. It is the duty of attached veterinary personnel to inspect all meats and dairy products entering and leaving the refrigeration plant for compliance with specification requirements and for sanitary condition, and to inspect and pass upon the fitness for food of all animals slaughtered by the Army for food purposes. Sanitary inspection includes the determination of any spoilage or deterioration arising subsequent to the time of original inspection, sanitation of equipment, exposure of perishables to adverse conditions of temperature, humidity, foreign gas, etc. They may also be called upon to render technical assistance when necessary.

[A. G. 062.11 (6-27-40).]

BY ORDER OF THE SECRETARY OF WAR:

OFFICIAL:

E. S. ADAMS,
Major General,
The Adjutant General.

G. C. MARSHALL,
Chief of Staff.